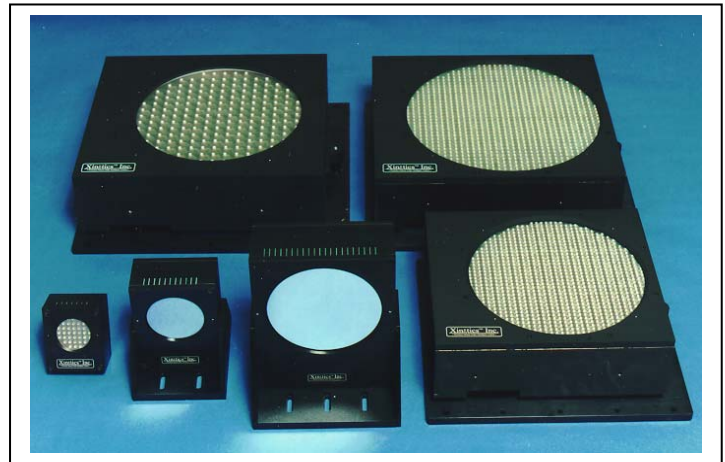


PMN DEFORMABLE MIRRORS

CORE TECHNOLOGY PROFILE:

Xinetics has preserved critical deformable mirror technology based on lead magnesium niobate (PMN) electroceramic actuators. Its commercial deformable mirror product has not only helped astronomer's see the very beginnings of time but has also helped ophthalmologist's see the very beginnings of eye disease. Our PMN actuated deformable mirror product is driven routinely in high-speed adaptive optics systems to 1×10^{11} cycles without failure. The critical element in making highly reliable deformable mirrors is the availability of precision actuators. By using the cofiring process, an actuator stack can be made which has very nearly the same modulus as the bulk ceramic material. **In the past twelve years, Xinetics has built and delivered over 200 mirrors that contain over 25,000 actuators.**



DEFORMABLE MIRROR FIRSTS:

Xinetics fabricates the highest quality deformable mirrors in the world today. It has expanded access to advanced imaging technology to research institutes, astronomical observatories, and commercial industry.

- ◆ University of Rochester Center for Visual Sciences – first images of individual photoreceptors in the living human retina.
- ◆ USAF Phillips Laboratory – built and fielded 941-channel DM systems for 3.5-meter class Government large aperture telescopes.
- ◆ W. M. Keck Observatory – first demonstration of dimensionally stable response when exposed to the 0 Celsius ambient conditions of Mauna Kea.
- ◆ Lockheed Martin Missiles and Space – first demonstration of operation in a high-energy laser train without using liquid cooling.
- ◆ University of Michigan – first demonstration of ten-fold fluence increase by using beam cleanup in a femtosecond pulsed laser.
- ◆ Xinetics deformable mirrors have achieved international exposure with deliveries in Germany, Japan, United Kingdom, South Korea, and Italy.

STANDARD MIRROR SIZES:

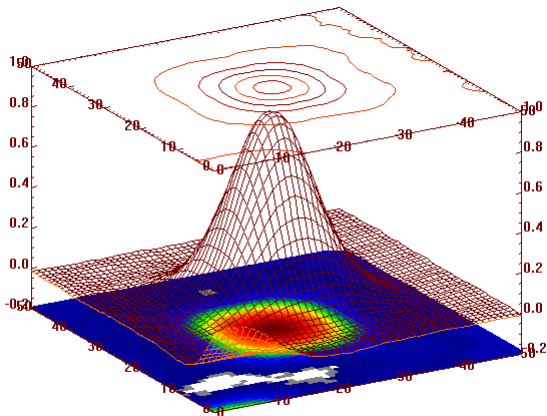
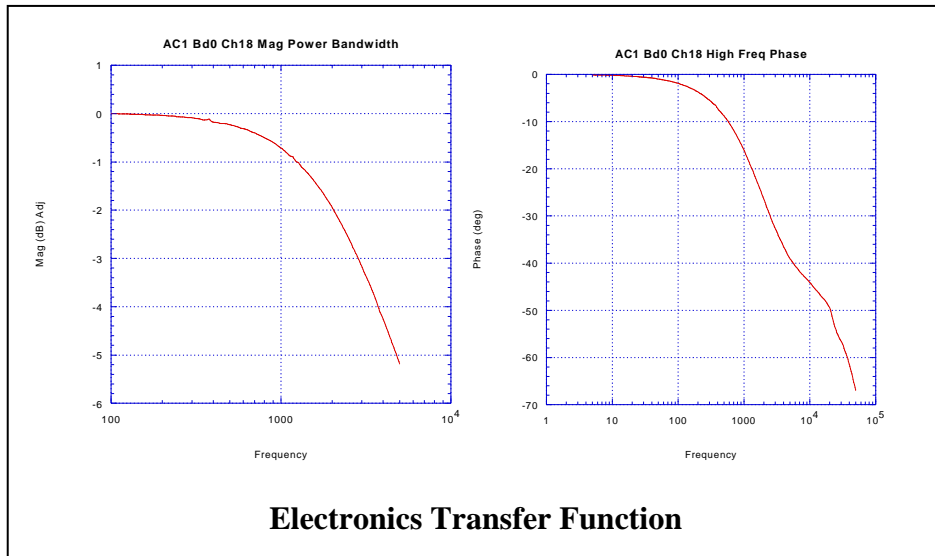
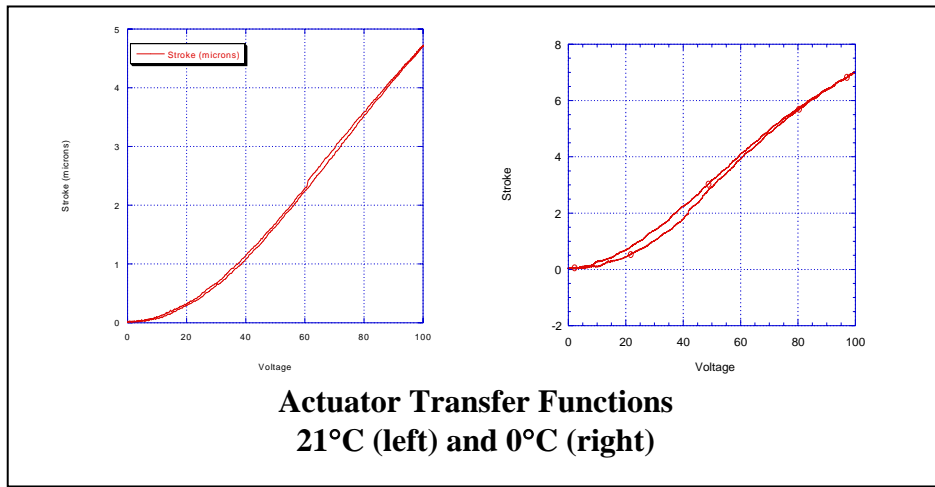
Xinetics mirrors range in size from 37 to 941 channels. Having athermalized Ultra-Low Expansion glass and PMN construction, the mirrors are dimensionally stable over a broad temperature range. The electrostrictive formulation PMN is the flagship actuator material. It features extremely low hysteresis, virtually no creep, and is the material of choice for precision positioning. In dimensional stability tests recently conducted at the Jet Propulsion Laboratory, PMN based mirrors were stable to $\lambda/2000$ at $0.63\text{-}\mu\text{m}$ for a period of months. Aluminum or Protected Silver coatings can be applied. Other coatings available upon request for additional cost

ELECTRONIC DRIVER SUMMARY:

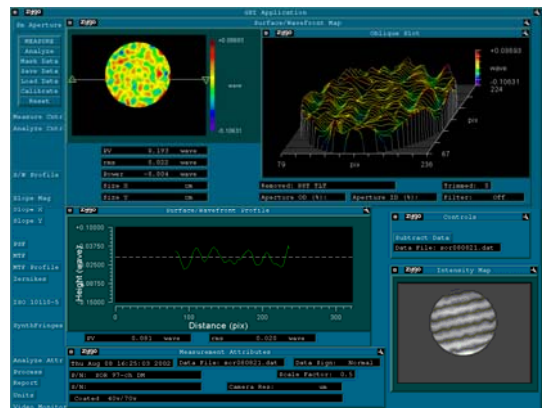
Xinetics has both high-speed and lower priced multiplexer driver electronics. The Xinetics drivers have a digital front end that uses a parallel interface, which can be connected to computers or reconstructors at rates up to 30 million commands/sec. Also, the design of a new driver confines all the electronics and power supplies to a single 4U subchassis. The high-speed systems can add a PC-based diagnostic system for monitoring operation and provide simple mirror control vs RS-232. A front panel display allows access to a wide variety of driver information.

PMN Deformable Mirror Product Options

PMN:RE Model	Channels	Stroke	Array	Spacing	Aperture	Layout
DM37PMNS4	37	4 μm	7x7	7 mm	47 mm	4.3x3.2x2.3"
DM97PMNS4	97	4 μm	11x11	7 mm	77.5 mm	6.0x4.5x2.5"
DM177PMNS4	177	4 μm	15x15	7 mm	105.4 mm	7.0x5.3x2.5"
DM349PMNS4	349	4 μm	21x21	7 mm	148.6 mm	9.8x7.3x3.0"
DM941PMNS4	941	4 μm	35x35	7 mm	241.3 mm	12.3x11.0x4.2"



Optical Influence Function



Mirror Surface After Flattening

Xinetics Inc.

Precision Motion Under Intelligent Control

PARAMETER	PMN Actuator
Actuator Spacing	7 mm
Stroke	4 μm
Actuator Coupling	<10%
Actuator Hysteresis	<1%
Actuator Uniformity	3% Nominal
Actuator Linearity	5% Nominal
Drive Voltage (Max)	100 Volts
Capacitance	1.8 μF
Full Amplitude Bandwidth	≥ 2 kHz
Surface Figure (unpowered)	$\leq \lambda/4$ ($\lambda=633$ nm)
Surface Finish	20 \AA rms
Scratch/Dig	60/40
Operating Temperature	-10 to +40°C
Optical Coatings	Aluminum or Protected Silver

SPECIFICATIONS

